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(54) REFRACTORY HEAT INSULATING MATERIALS

(71) We, FOSECO INTERNATIONAL LIMITED, a British Company of 285, Long Acre, Nechells, Birmingham 7, England, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to refractory heat-insulating materials for use in casting molten metal. Though their use is not so limited, the materials according to the present invention are of principal value in the casting of steel, because of their properties at very high temperatures.

According to the present invention, there are provided refractory heat-insulating materials which comprise 1-20% by weight of aluminium, magnesium, silicon or zirconium in particulate form, 10-97% by weight of a refractory fibrous component selected from aluminosilicate fibre, zircon fibre and silica fibre, and a binding agent comprising an organic binder and colloidal silica sol.

It is found that riser sleeves, hot-top lining slabs, feeder heads and like shapes made of such refractory heat-insulating materials can be used satisfactorily in the casting of steel, at high temperatures such as 1600-1650°C. It is believed that the cause of unsatisfactory performance of riser sleeves of other types is the presence of molten oxides, e.g. of iron and manganese on the surface of the steel, which tend to flux away and destroy many of the ingredients of previous refractory heat-insulating compositions, and thus render them ineffective. It is believed that in the present case, the metal in the heat-insulating material reduces the molten iron oxide to iron, with the production of a highly refractory oxide which forms a protective layer over the steel-contacting surface of the heat-insulating material. It is found that by the use of the present invention, refractory heat-insulating materials may be produced which are usable with steel but have a comparatively low density (and low thermal conductivity). Prior materials have been insufficiently refractory for use with steel. By means of the invention, materials which are usable with steel but have a density of below 0.5 gm/cc may be produced.

The materials of the present invention may include in addition to the components noted above, particulate refractory fillers such as crushed coke, alumina, magnesia and silica and other very highly refractory materials. These may constitute 10-87% by weight of the heat insulating material.

The organic binder may be an organic gum or resin, but the preferred organic binder is starch. The binding agent preferably constitutes from 2-16% by weight of the heat insulating material.

The particulate metal used is preferably of a grading such that at least 99% by weight will pass a 0.053 mm opening mesh.

The method of formation of the heat-insulating material is preferably that of forming a slurry of the ingredients in a liquid medium (usually water) and sucking the liquid through a mesh former so as to deposit on the former a body of the slurry solids, and subsequently removing and drying the coherent shape so formed.

A particular process for producing such materials is described in Specification No. 1204472. The slurry solids content employed is preferably in the range 0.1 to 10% by weight.

The following examples will serve to illustrate the invention:

EXAMPLE I

A 1% solids content aqueous slurry was made up by adding the following ingredients in the proportions by weight stated:

Aluminosilicate fibre	71.44%
Aluminium (99%<0.053mm)	7.14%
Colloidal silica sol	14.28%
Starch	7.14%
	100%

The aluminosilicate fibre had an analysis, by weight of 42-57% Al_2O_3, 45-57% SiO_2 and 1-6% TiO_2, together with traces of other oxides.

This slurry is dewatered into a cylindrical mesh former to deposit a sleeve of thickness 12mm, which was stripped from the former and dried at 160°C for 2½ hours. Such a sleeve was used as a riser sleeve in a large steel casting, other risers of which were lined with commercial riser sleeves of the same dimension. After casting, the risers were examined. The commercial sleeves were badly damaged and the risers showed a quantity of pipe, indicating insufficient thermal insulation. The riser sleeve according to the invention was substantially undamaged, and the solidified riser had a fairly flat top and showed no pipe into the casting.

EXAMPLE 2

A 1% solids content aqueous slurry was prepared by adding the following ingredients in the proportions by weight stated:—

Aluminosilicate fibre	61%
Starch	6%
Colloidal silica (as 30% SiO_2 sol)	5.5%
Aluminium powder (99.7%<0.053mm)	9%
Alumina	17.5%
Aluminium sulphate	1%

Using the process described in Specification No. 1204472 75mm × 150mm high sleeves were produced. The density was 0.30 - 0.40 g/cc.

One such sleeves was used to feed a 120mm cube (a standard laid down by the Steel Foundries Society of America) the assembly being moulded up in silicate-bonded sand. A bottom running system was used and the casting was produced from fully killed, 0.24-0.40 carbon steel, at a ladle temperature of 1590±10°C. The surface of the metal in the sleeve was covered with a layer of FERRUX 40 anti-piping compound. (FERRUX is a Registered Trade Mark).

After casting the sleeve stripped easily from the riser giving a smooth surface free from penetration or dilation. On sectioning the casting was found to be sound.

EXAMPLE 3

Comparative tests were carried out using two sleeves, one of which contained aluminimm.

Low-solids-content slurries were prepared by dispersing the following materials in 400 litres of water:—

(A) Aluminosilicate fibre	1500 g
Starch	140 g
Colloidal silica sol (30% SiO_2 by wt)	400 g
Aluminium sulphate	25 g
(b) Aluminosilicate fibre	1500 g
Starch	140 g
Colloidal silica (30% SiO_2 by wt)	400 g
Aluminium sulphate	25 g
Aluminium powder (99.7%<0.053mm)	300 g

Using the process described in Specification 1204472 75 mm internal diameter 150 mm high sleeves of wall thickness 12mm were formed using a forming time of 60 seconds. These sleeves were then used to riser 120mm cube steel castings and the folowing results were obtained.

The sleeve which did not contain aluminium produced a poor riser surface due to slagging and metal penetration, appreciable dilation, and also unsoundness in the casting. However, the sleeve containing aluminium gave considerable improvement with regard to slagging, penetration and dilation, and its feeding characteristics were good.

Dilation was assessed by measuring the diameter of the riser: at its base the dimensions were 75mm in the case of the sleeve containing aluminium and 96mm in the case of the sleeve without aluminium.

Feeding characteristics were assessed by measuring the pipe depth in cms. from the interface between the riser and the casting, the results being recorded as positive into the riser and negative into the casting. The sleeve containing aluminium produced a pipe depth of + 3.6 cm while the sleeve without aluminium produced a pipe depth of −5.5 cm.

WHAT WE CLAIM IS:—

1. A refractory heat-insulating material comprising 1-20% by weight of aluminium, magnesium, silicon or zirconium in particulate form, 10-97% by weight of a refractory fibrous component selected from aluminosilicate fibre, zircon fibre and silica fibre, and a binding agent comprising an organic binder and colloidal silica sol.

2. A refractory heat-insulating material according to claim 1 which contains a proportion of a particulate refractory filler.

3. A refractory heat-insulating material according to claim 2 wherein said proportion is 10-87% by weight.

4. A refractory heat-insulating material according to claim 2 or 3 wherein said refractory filler is selected from crushed coke, alumina, magnesia and silica.

5. A refractory heat-insulating material according to any of claims 1-4 wherein the

binding agent constitutes 2-16% by weight of the material.

6. A refractory heat-insulating material according to any of claims 1 to 5 wherein the organic binder is starch.

7. A refractory heat-insulating material according to any of claims 1-6 wherein at least 99% by weight of the particulate metal used will pass a 0.053 mm opening mesh.

8. A refractory heat-insulating material according to claim 1 substantially as hereinbefore described in any one of the foregoing specific examples.

9. A refractory heat-insulating material acording to any of claims 1-8 in the form of a slab or sleeve.

10. A lining for a riser, feeder head, hot top or mould for casting steel which is formed from sleeve or slabs as defined in claim 9.

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